products of the liver cells, preferably the bile pigments, carrying them to the malignant growth. Hence the latter may wear both on its surface and in its interior a distinct yellow appearance, due to the aggregation of "jaundiced" pyrrhol cells. Since the tumour evidently suffers through the application of the above-mentioned substances, it does not seem improbable that the pyrrhol cell is also active in transporting substances to the tumour which impede, and in many cases stop, its growth.

Antelope and their Relation to Trypanosomiasis.

By Dr. H. L. Duke.

(Communicated by Sir J. R. Bradford, Sec. R.S. Received February 26,—Read March 28, 1912.)

[Plate 2.]

The flies on the Chagwe Lake shore are still capable of infecting monkeys with *Trypanosoma gambiense*. Four years and a-half have now elapsed since the Chagwe coast line was officially declared free of population, all villages destroyed within a zone of two miles bordering the lake, and their inhabitants removed inland. In spite of precautions, however, there is very little doubt that the islanders continued secretly to visit the mainland until they also were removed in 1909, and all the island villages destroyed. Since September, 1909, therefore, there have been no natives in the fly area except the recalcitrant few, who, at the risk of imprisonment, may from time to time return to their old haunts on the mainland or the islands. Instances of this have indeed occasionally occurred up to the time of writing. Apart from the captures made by the Government patrol, I have on several occasions had to report signs of recent native occupation within the prohibited area seen in the course of excursions from Mpumu.

In considering the question of the infectivity of the lake-shore flies, the possibility of infected natives being available as a food supply must still be considered, although this factor is apparently of small importance. These natives would most likely only venture forth at night time, and would be unlikely to approach the fly ground, which is visited almost daily by the boys from Kibanga. There remain the canoemen and fly-boys employed by the Laboratory, and in this connection it can only be said that, although

frequently examined, they have never shown any sign of Sleeping Sickness either clinically or upon blood examination.

As all the mainland flies in the following experiments were caught upon a short stretch of shore to the west of the mouth of Buka Bay, which is visited several times weekly, it is extremely improbable that stray natives alone could account for the prolonged infection. The suspicion that either the antelope or reptiles which frequent the lake shore are acting as a reservoir for *T. gambiense* becomes increasingly probable the longer the wild flies remain infective. As to whether reptiles can serve as a reservoir, the difficulty of obtaining live crocodiles or water-lizards has, up to the present, prevented any satisfactory investigations being carried out on this point. That the buck are important in this connection was foreshadowed by results obtained in the laboratory experiments with these animals, some of which have proved capable of infecting laboratory-bred *Glossina palpalis* more than twelve months after their original infection with *T. gambiense*. If an infected buck took up its quarters in the forest behind the fly ground, it might account for the recent outburst of infectivity among the fly after a long period of relative quiescence. From prolonged observation, it would appear that bushbuck, at any rate, among the antelope frequenting the lake shore are very limited in their feeding range.

The objection that these animals would not, by virtue of their nocturnal habits, be exposed to the bites of the fly, may be dismissed at once. On several occasions I have seen bushbuck feeding at the water's edge as late as 8.30 A.M., long before which time the sun is powerful and the fly actively aggressive. Upon one occasion a herd of waterbuck was seen actually in the water at 11 A.M., in the full glare of the sun. Situtunga also, as will be seen later, are by no means so exempt from the attentions of the fly as the general impression of their habits would suggest.

Against the objection that the thick hair of an antelope would prevent a fly from piercing the skin over the greater part of the body, I may say that I have observed Stomoxys in numbers vigorously sucking blood on the haunches and sides of the body of a newly-killed bushbuck, regions where the hair is exceedingly thick.

As regards the possibility of the longevity of the fly affording a solution of the problem, I am unaware of any evidence of *G. palpalis* surviving for more than 227 days—an observation recorded by Dr. Kleine. With a view, then, to completing the chain of evidence incriminating the lake-shore antelope, the experiments given below were undertaken. Owing to the nature of the country, the expectations of a positive result from the mainland were extremely poor, as the places where buck can be shot are not necessarily

places where fly abound. In the immediate vicinity of the fly ground the thick forest absolutely precludes shooting. The results obtained on Damba by Hammerton and Bateman in 1910, and again by Carpenter in May, 1911, showing that the flies on this uninhabited island are apparently maintaining their infectivity undiminished, suggested the scene for the experiments. The only species of antelope found upon the islands of Lake Victoria Nyanza is the Situtunga (*Tragelaphus spekei*). Since the removal of the natives from Damba, these animals have increased greatly in numbers, and at present their tracks may be seen at almost any suitable point on the shore of the island. As will be seen below, events justified the experiment and revealed the parallel in nature to the infections induced in the laboratory.

These investigations include, in addition to antelope, all other available vertebrates whose habits bring them into contact with the fly. In every case where possible the citrated blood was injected into a monkey and a goat and smears prepared. On rare occasions fresh preparations were examined. Certain mammalian trypanosomes other than *T. gambiense* were obtained in the experimental goats, and these are also discussed below.

The following is a brief summary of the experiments on the infectivity of the wild flies for *T. gambiense*, carried out during the period April, 1911, to January, 1912, covered by the paper:—

Table I.

Date.	Experiment.	No. of flies used.	Result.	Source of flies.
1911.				
Apr. 3—May 10	4	6144	+	Kibanga.
May 15—28	56	1050	+	,,
June 7—July 18	113	5385	+	,,
July 31—Aug. 31	234	6360	—	,,
Sept. 10—22	386	3310	—	Lwagi Island.
,, 10—22	387	3250	—	,,
Oct. 11—Dec. 5.....	459	6150	—	Kibanga.
Dec. 11—27	563	3190	+	,,

Remarks.—Four and a half years after the removal of the natives from the Chagwe coast line, and two years after the final clearing of the neighbouring islands, there is a percentage of 0·014 infective flies in a total of 28,279 caught at Buka Point, assuming that there is only one infective fly to each positive experiment. On Lwagi Island, where there are no antelope, it was impossible to obtain a sufficient number of fly to constitute evidence on the subject of *T. gambiense*. It will, however, be seen below that there are some grounds for believing that the negative results obtained with Lwagi flies are due to the absence of antelope from this island.

The actual injection experiments will now be considered. Each species of antelope is dealt with in a separate table, the remaining animals being grouped together. A blank space occurring in any column of the tables indicates that there is nothing to record under that heading.

Table II.—Waterbuck.

Date.	Expt. No.	Locality.	Microscopical examination.		Blood injection.				
			Result.	No. of films.	Time after death of animal.	Monkey.		Goat.	
						Quantity.	Result.	Quantity.	Result.
					hrs.	c.c.		c.c.	
21.4.11 ...	15	Enfufu ...			2	3	—	5	—
21.4.11 ...	15	„ ...			2	3	—	5	—
28.4.11 ...	26	Kyetume			3	3	—		
24.8.11 ...	324	Kibanga...	—	4	3	3	—	8	—
2.12.11 ...	544	„ ...			1½	3	—	6	—

Remarks.—With the exception of Expt. 26, all these antelope were shot within the prohibited area and may be considered as more or less frequent visitors to the lake shore.

Table III.—Bushbuck.

Date.	Expt. No.	Locality.	Microscopical examination.		Blood injection.				
			Result.	No. of films.	Time of injection after death of animal.	Monkey.		Goat.	
						Quantity.	Result.	Quantity.	Result.
					hrs.	c.c.		c.c.	
30.4.11 ...	28	Bugala	—	3	4½	3	—	5	—
30.6.11 ...	183	Kibanga.....	—	6					
30.6.11 ...	185	„	*T. uniforme* + + +						
6.8.11 ...	249	Buwera	—	3	1½	4	—	10	—
13.8.11 ...	293	„	—	3	2	4	—	10	—
20.8.11 ...	312	Ebyoba			1	3½	—	10	—
2.9.11 ...	353	Kibanga.....	—	2	1	3	—	8	—
27.9.11 ...	396	Kivuvu	—	8		3	—		
19.9.11 ...	405	Ebyoba	—	3					
5.10.11 ...	435	Namusenyu	—	3	1½	3	—	10	—
20.9.11 ...	466	Ebyoba	—	2	1	3			
19.10.11	472	Namusenyu	—	2	1½	3	—	5	—
21.10.11	479	Ebyoba	—	2	1			6	—
22.10.11	481	„	—	2	1½			5	—
22.10.11	482	„	—	2	1			3	—

Remarks.—With the exception of Expt. 396, all these buck were shot within a few hundred yards of the water's edge, and some actually on the lake shore. In only one case were trypanosomes discovered, *i.e.* Expt. 185, in whose blood an organism answering morphologically to *T. uniforme* was present in large numbers.

Table IV.—Hippopotamus, etc.

Animal.	Date.	Expt. No.	Locality.	Microscopical examination.		Blood injection.				
				Result.	No. of films.	Time after death of animal.	Monkey.		Goat.	
							Quantity.	Result.	Quantity.	Result.
						hrs.	c.c.		c.c.	
Hippo ...	23.4.11	17	Damba	—	2	2	3	—	5	—
,, ...	4.6.11	106	Namusenyu ...	—	2	3	2½	—	5	—
,, ...	11.6.11	132	Kibanga	—	2	2	2½	—	5	—
,, ...	10.9.11	469	Senkua Island	—	2	3	3	—	10	—
,, ...	11.9.11	470	Lwagi Island...	—	2	1			10	—
,, ...	19.9.11	404	Ebyoba	—	2	3½			6	—
,, ...	19.9.11	471	,, ...	—	2	4	4	—		
,, ...	20.9.11	408	Senkua Island	—	2	7			6	—
,, ...	24.9.11	409	Damba Island	—	2	3½	3	—		
,, ...	24.9.11	406	,,	—	2	3½	3	—		
,, ...	25.10.11	498	Kibanga			1½	4	—		
,, ...	4.11.11	547	Damba	—	2	3½	3	—		
Buffalo	4.5.11	37	Near Kyetume	—	4	1½	3	—	5	—
,,	4.5.11	38	,,	—	4	1½	3	—	5	—
,,	11.5.11	49	Kibanga	—	4	4	3	—	5	—
,,	1.6.11	99	Near Kyetume	—	4	1	2½	—	5	—
,,	29.6.11	180	,,	—	4	1	2½	—	5	—
,,	31.10.11	499	Wankobe	—	2	1½	3	—	6	—
Wild pig	1.4.11	3	Kibanga	—	2	1	3	—	5	—
Otter ...	4.6.11	109	Namusenyu ...	—	4	2	2½	—	3	—

Remarks.—Expt. 499 was shot far inland. Expts. 37, 38, 99, and 180 were shot on the borders of the prohibited area. It is, however, probable that the herds, in the course of their wanderings, reach the lake shore from time to time, so that they may be considered in the present discussion. All the other animals in Table IV were shot along the lake edge.

On numerous occasions trypanosomes have been studied in the blood of Situtunga 173 and 356 (see Table V). These agree with *T. uniforme* as regards morphology and movement. Repeated attempts to subinoculate from both these antelope into sheep and goats have, however, up to the present failed. This failure to infect goats with the blood of game known to contain trypanosomes morphologically identical with *T. uniforme* has been already reported by Fraser and myself.

Experiments on these two antelope conducted with laboratory-bred *G. palpalis* show that only the proboscis is infected, the hypopharynx invariably containing a small number of free trypanosomes. This is another point of agreement with *T. uniforme*, which would thus appear the commonest antelope trypanosome of the Mpumu neighbourhood.

The organism referred to above as *T. ingens* in Experiment 173 has only been observed in fresh preparations. It is a large trypanosome with a constant, slow, rippling motion and a very wide undulating membrane. The

Table V.—Situtunga.

Date.	Expt. No.	Locality.	Microscopical examination.		Blood injection.				
			Result.	No. of films.	Time of injection after death of animal.	Monkey.		Goat.	
						Quantity.	Result.	Quantity.	Result.
31.7.11	173	Kibanga	*T. uniforme* + *T. ingens* +	?	Immediate	Several experiments	—	Several experiments.	—
30.6.11	551	,,	*T. ingens* +	4					
10.8.11	284	,,	—	6					
16.8.11	302	,,	—	3	3 hrs.	3 c.c.	—	8	—
22.8.11	317	,,	—	5	1 hr.	3½ ,,	—	6	—
28.8.11	332	,,	—	3	1 hr.	3 ,,	—	8	—
2.9.11	356	,,	*T. uniforme* +	?	Immediate	4 ,,	—	Several experiments	—
25.9.11	402	Damba Isle	—	3	2 hrs.	3 ,,	*T. gamb.* +		
25.9.11	403	,,	—	3	1 hr.	4 ,,			
5.11.11	509	,,	—	4	1 hr.	4 ,,		10	*T. vivax* +
6.11.11	510	,,	*T. uniforme* + fresh and stained		1 hr.	3 ,,	*T. gamb.* +	8	*T. uniforme* + *T. gamb.* +

Remarks.—Situtunga Expts. 173 and 356 are still alive at the laboratory.

T. ingens of Experiment 551 was seen in stained preparations and answered to the description given by the 1908–10 Commission for this trypanosome.

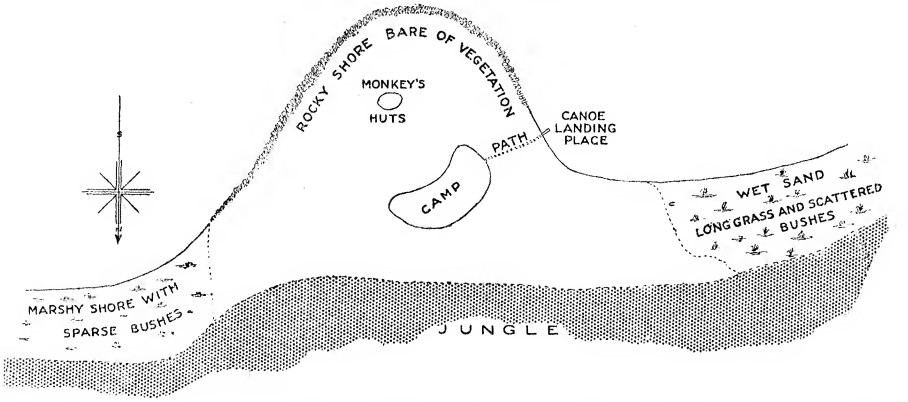
The reasons for the diagnosis of *T. gambiense* in the above table will be given below. It may be mentioned that Situtunga 173 has developed *T. gambiense* in its blood after being fed upon for five days by flies infected with this trypanosome.

The obtaining of *T. gambiense* from Experiments 402–3 and 509–10 are, of course, by far the most important result so far obtained during the examination of the lake-shore game. It is, therefore, necessary to consider fully all possible sources of fallacy in these experiments and to exclude them as far as possible. Upon this question Dr. Carpenter, at whose camp on Damba Island I made my headquarters, has kindly expressed his views as follows:—

The "Situtunga" Experiment.

"On considering this important result a possible source of fallacy at once suggests itself, namely, that as the monkey was infected whilst on Damba Island, the trypanosomes may have come from a glossina, for I have shown in a 'Progress Report' that the Glossinæ on Damba Island are still capable of infecting a monkey.

"This objection, formidable as it is on paper, is not so when the local conditions are thoroughly appreciated. In the first place, that part of the coast line where is the little promontory on which my camp has been since March is not sufficiently shaded for Glossinæ, which are only present in very small quantity. Moreover, the whole locality round the camp has been very completely cleared, and the edge of the jungle at the base of the promontory, in which there are few flies, is some 50 yards away from the nearest hut, and 100 yards at least from the monkey's quarters.



"Also, if an occasional fly should accompany the canoe back from that part of the shore where flies are very numerous (nearly two miles away to the south-west) it would not be carried on to the monkey's quarters, but would be intercepted by the boys' huts. As a matter of fact it is an exceptional occurrence to see any Glossinæ in the cleared area, and those that are occasionally seen are probably the bred flies which have escaped during manipulations, and these very quickly leave the locality.

"It might be suggested that one of these may have bitten an infected canoeman or fly-boy, and, subsequently, the experimental monkey; but I think it must be an exceptional occurrence for a monkey to be bitten by a glossina. A tame monkey which has been with me on the island since April, and *has never become infected*, is immediately aroused to alertness, even when half asleep, by the buzz of a glossina, and when one of my bred flies accidentally escapes the monkey is all eagerness to catch it, whereas an ordinary fly attracts little attention.

"Moreover, I have no reason to suppose that any of the natives with me on the island are potential sources of *T. gambiense*, and blood from all the fly-boys (who are most exposed to infection) has been injected into a monkey with negative result.

"(Signed) G. D. H. Carpenter,
"Damba Island, November, 1911."

It may in addition be pointed out in the case of Experiments 509–510 that both monkey and goat developed *T. gambiense*—confirmed in the latter by sub-inoculation into a monkey as well as in stained preparations; moreover, the goat was tethered in the camp some distance from the monkeys' boxes.

Since May, 1911, Dr. Carpenter has always had two monkeys in residence in the boxes left by Hammerton and Bateman, and though examined from time to time he has never had a case of spontaneous infection by stray flies. The following is a brief history of the animals which serve as a control to my experiments on Damba Island:—

Monkey A.—Arrived Damba, May 1, 1911, and was immediately used to test infectivity of wild Damba flies. Became infected on May 15, and was immediately shot.

Monkey B (into which the blood of Situtunga 402–3 was injected).—Arrived Damba, May 25, 1911, and between then and September 25, when the injections were made, a period of four months, was examined on 19 occasions, with negative results. On October 2 was negative, and on October 3 Dr. Carpenter first discovered trypanosomes in its blood.

Monkey C.—Arrived Damba, May 29, 1911, and from that date was used by Dr. Carpenter to test the infectivity of wild *G. palpalis* from the neighbourhood of Damba. It was examined on 36 occasions with no result during the ensuing five months. On November 6 it became infected, having by this time been fed upon by several thousands of wild fly.

Monkey D.—Tame monkey kept by Dr. Carpenter, and exposed to all the risks run by the experimental monkeys. Arrived Damba, March, 1911. In perfect health up till October 9, 1911, when, at my request, it was first examined. Since that date has been examined weekly, and has never shown trypanosomes, and is in perfect health.

Monkey E (into which blood of Situtunga 509–10 was injected).—Arrived Damba, October 8, 1911, having previously been examined regularly at Mpumu with negative results. Examined daily from November 3 to November 17 inclusive, with negative results. On November 5 and 6 received blood of Situtunga 509–10, respectively. On November 18 trypanosomes first appeared in its blood.

Monkey F.—Arrived on Damba, November 3, 1911, in perfect health. On November 4 injected with the blood of hippo, Experiment 547 (*cp.* Table IV). Between November 3 and December 12 examined on 21 occasions, with negative results. At present in excellent health.

Finally, it may be pointed out that the incubation period in the case of all three positive experiments was in keeping with previous experience. Thus

Monkey 401 first showed trypanosomes on the eighth day after inoculation. Monkey 511 showed first 13 days after the first injection, and Goat 512 developed *T. uniforme* 10 days, and *T. gambiense* and *T. vivax* 15 days after inoculation. With reference to the prolonged incubation period in the case of Monkey 511, it may be noted that, in the only case where an inoculation from the laboratory antelope has recently proved positive, the incubation period in the monkey before trypanosomes appeared was 18 days.

A consideration of the conditions on Damba Island affords a vivid picture—a vicious circle in constant operation, only awaiting the reappearance of the natives to reproduce the recent epidemic. With the exception of papyrus areas, practically the whole shore line of the island is to a greater or less extent fly-ridden, one portion being occupied by the famous fly-beach, from which for several years some thousands of pupæ have been brought monthly to Mpumu. In his recent report to the Royal Society, Carpenter describes an infection of a monkey with 885 flies caught in May, 1911, on this pupa ground. The situtunga are multiplying rapidly in the absence of the natives, and are far less restricted in their range than formerly. The common conception regarding the habits of this antelope, as being a creature spending its days in the papyrus swamps where no fly are found, and only visiting dry land at night to feed, does not apply to Damba. During the short time I spent on the island, I frequently saw situtunga from the canoe at the water's edge both morning and evening. As late as 9 A.M. I have seen them feeding among the ambatch stems in places where fly were numerous, and where it required constant vigilance to avoid being bitten. On one occasion I observed a female on the actual pupa-beach at 8.30 A.M. in the full glare of the sun. There is also a long extent of shore, where, owing to comparatively recent sinking of the lake level, there is now a strip of grass and bushes some 40–50 yards wide, dotted here and there with ambatch trees, between the forest and the water's edge. This is a favourite haunt of the situtunga, and tsetse are present throughout its extent. There is therefore every natural facility for that frequent interchange of infection between fly and buck which constitutes a true reservoir.

On the neighbouring coast of the mainland, the fly are probably brought into far less frequent contact with antelope. The stretches of shore where fly are numerous are few and far between, and the number of antelope which actually visit any given fly area would be small. On the mainland also, the situtunga would probably only be available to the fly residing in the immediate neighbourhood of the papyrus, and thus the most typically lake-shore antelope would be denied to the fly where the latter are most numerous.

Finally, the following table may be considered as supplying additional evidence on the part played by antelope as a trypanosome reservoir :—

Table VI.

Date.	Expt. No.	No. of flies used.	Result.	Source of fly.	Experimental animal.
1911.					
May 16—24.....	58	1100	*T. gambiense* + *T. uniforme* +	Kibanga	Goat.
July 24—Aug. 2...	223	1220	*T. uniforme* +	„	„
Sept. 27—Oct. 4 ...	400	1560	*T. uniforme* + *T. vivax* +	„	„
„ 9—22.....	384	4258	—	Lwagi Island ...	„

Remarks.—It will be seen from this table that in the first three experiments, comprising in all 3880 mainland flies caught at Buka Point, *T. uniforme*, with or without *T. vivax*, appeared on all three occasions. A total of 4258 flies caught on Lwagi Island, where there are no antelope, but only hippo, birds, and reptiles, failed to produce either of these trypanosomes.

Diagnosis of the Trypanosome Obtained in Monkeys 401 *and* 511.

There seems no reason to doubt that the trypanosome obtained in monkeys from the blood of Situtunga 402–3 and 509–10 is identical with the species obtained by Hammerton and Bateman from wild Damba flies in May–June, 1910, and again in May, 1911, by Dr. Carpenter. The Damba natives suffered severely during the epidemic, as the conditions on the island ensured constant exposure to the bites of the fly. These fly are still infective to monkeys, and the trypanosome carried by them answers to *T. gambiense* morphologically, and as regards the disease in monkeys.

In the face of such facts a more comprehensive examination seemed hardly necessary. In the present instance, however, the importance of the issue at stake makes a careful investigation imperative.

Of the trypanosomes previously described from Uganda *T. brucei* is the only one which claims attention. Other species as *T. pecaudi* and *T.* "*dimorphon*" are also suggested by the morphology. The fact that *T. brucei* is supposed to be non-pathogenic to man emphasises the importance of excluding this species in diagnosing a trypanosome derived from wild antelope.

Behaviour of the Damba Trypanosome in Glossina palpalis.

In an experiment comprising 101 clean laboratory-bred *G. palpalis* fed upon Monkey 401, whose blood contained the Damba trypanosome, two infected flies were obtained on the 17th and 57th days respectively.

The clean monkey upon which they were fed developed trypanosomes answering to *T. gambiense*. The 57th day fly showed a typical *T. gambiense*

Table VII.

Origin of trypanosome.	Experiment No.	Microns.																		Average.
		17.	18.	19.	20.	21.	22.	23.	24.	25.	26.	27.	28.	29.	30.	31.	32.	33.	34.	35.	
Situtunga 402-3.....	401, monkey		2	2	1	4		2	1			3	1	1		2	1				24·4
„ „	477, rat		2		2		1	5			3	3	1	1	1	1					24·3
„ „	504, monkey			2	1	1			1	2	2	2	1	2				1	3	2	27·4
„ „	543, „	2	1	1		2	1	2	1	1	1	2	2	4							23·7
„ „	571, rat		1		3	5	2				1										20·1
„ „	573, dog				1		2	5	1	2	1	3		1	1	1	1	1			25·6
Situtunga 509-10	(1) 511, monkey			1	3	3	5	3	1	1	1	2									22·35
„ „	(2) 511, „			2		5	6	2	2	1					1						22·0
„ „	525, „			2	1	2	1	4	1	1	2	2	1								23·5
„ „	574, dog			1	1	2	1	3	4	3	1	1	3								23·9
Totals	.....	2		19	13	24	19	26	12	14	12	18	9	9	3	4	2	2	3	2	
Percentages ...	.....	1	3·5	9·5	6·5	12	9·5	13	6	7	6	9	4·5	4·5	1·5	2	1	1	1·5	1	

infection of gut, proventriculus and salivary glands, the proboscis being negative. This latter fact would point to the exclusion of *T. pecaudi* and *T. dimorphon* from the differential diagnosis. A second experiment, in which 51 laboratory-bred flies were used, proved negative.

An experiment comprising 79 laboratory-bred *G. palpalis* fed upon Monkey 511 gave one infected fly on the 42nd day. The gut only contained trypanosomes. The clean monkey upon which these flies were fed ran away without having ever shown trypanosomes.

Morphology.—Dimorphism marked, the extremes 35 μ and 17 μ. The long or short type may predominate from day to day, but intermediate forms are always present. Forms over 31 μ in length are very uncommon; the longest examples were met with in Experiment 504, a monkey infected from Experiment 401, through laboratory-bred flies.

Table VII on opposite page shows the distribution of length in 10 experimental animals.

The Protoplasm is devoid of granules in all preparations examined from goats and monkeys. In both the rats examined granules were present in numbers both behind and in front of the nucleus.

Table VIII.—Animal Reactions.

Animal.	Expt. No.	Source of virus.	Incubation.	Duration.	Remarks.
			days.	days.	
Monkey	401	Situtunga 402–3	8		Alive after 124 days; shows considerable emaciation; no lethargy.
,, ...	511	,, 509–10	12–13		Alive after 82 days; no obvious symptoms.
,, ...	504	Flies from 401	?		Alive after 75 days; in good health.
,, ...	525	Goat 512	10		Alive after 70 days; in good health
,, ...	543	Calf 478	10		Alive after 54 days; in good health.
,, ...	575	Goat 579	6		Alive after 42 days; in good health.
Rat, white...	477	Monkey 401	5	83	
,, ...	571	,,	5		Alive after 42 days; slight emaciation; lively.
Guinea-pig	458	,,	10	61	
,,	572	Rat 477	20		Alive after 42 days; apparently in excellent health.
Goat	512	Situtunga 509–10	15 (?)		Alive, and apparently in good health, after 82 days.
,, ...	579	Monkey 401	?		Never showed trypanosomes, proved by sub-inoculation into monkey. Alive after 90 days; well.
Dog.....	573	,,	12		Alive after 42 days; in good condition.
,, ...	574	Goat 512	14		In very poor condition at time of inoculation and during the experiment.
Calf	478	Monkey 401	?		Proved by sub-inoculation into monkey. Trypanosomes seen on one occasion 51 days after inoculation. No obvious symptoms after 99 days.

A free portion is always discernible in the flagellum, though, in the case of the stumpy forms, it is often extremely short.

Movement.—No marked translation; remains actively wriggling in one spot, making occasional short gliding excursions about the field. Often the side-to-side movements are of a jerky character.

These experiments though few in number afford valuable evidence in favour of *T. gambiense* to the exclusion of *T. brucei*. The sub-chronic type of the disease in rats is perhaps the most striking point in the above table.

Action of Human Serum.—The assumption that *T. brucei* is non-pathogenic to man rests chiefly on the susceptibility of this trypanosome to human serum. Laveran and Mesnil,* in describing the action of this serum on animals infected with *T. brucei*, confine their attention chiefly to rats. The following experiments in which animals suffering from the Damba trypanosome were treated with human serum may now be considered:—

Animal.	Ultimate source of virus.	Quantity of human serum inoculated.	Native supplying serum.	Condition of blood at time of inoculation.	Day after inoculation.									
					1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th
		c.c.												
Monkey 401	Situtunga 402–3	3½	B.	+ + +	+ 1 seen	—	—	+	+	+ +				
„ 511	„ 509–10	3½	Y.	+ +	—	—	—	—	—	—	+	+	+ +	
„ 391	Human strain ...	3	Y.	+ +	+ 1 seen	—	—	—	—	—	—	+ 1 seen	+	+ +
Rat 477 ...	Situtunga 402–3	1	Y.	+ + +	+ + +	+ +	+ +	+ +	+ +	+ + +				
„ 576 ...	„	1	Y.	+ +	+ +	+ +	+	+ +	+ + +					
Monkey 563	Wild lake flies ...	3½	Y.	+ +	—	—	—	—	+	+	+ +			

Remarks.—It will be seen that in every case where the human serum was injected into a monkey the trypanosomes disappeared from the circulation for a longer or shorter period. In the case of the rats this did not occur. It would thus appear that there is some condition present in monkeys which causes them to react to human serum, this condition not being present in rats. Experiments conducted *in vitro* on the same lines appear to confirm this conclusion. The negative results obtained with Rats 477 and 576, together with the positive result obtained with the human strain in Monkey 391, neutralises what at first appeared evidence in favour of *T. brucei*.

As regards the diagnosis of the three species of trypanosomes described in Goat 512 (Table V), the following methods were employed:—

(1) Examination of fresh blood preparations.

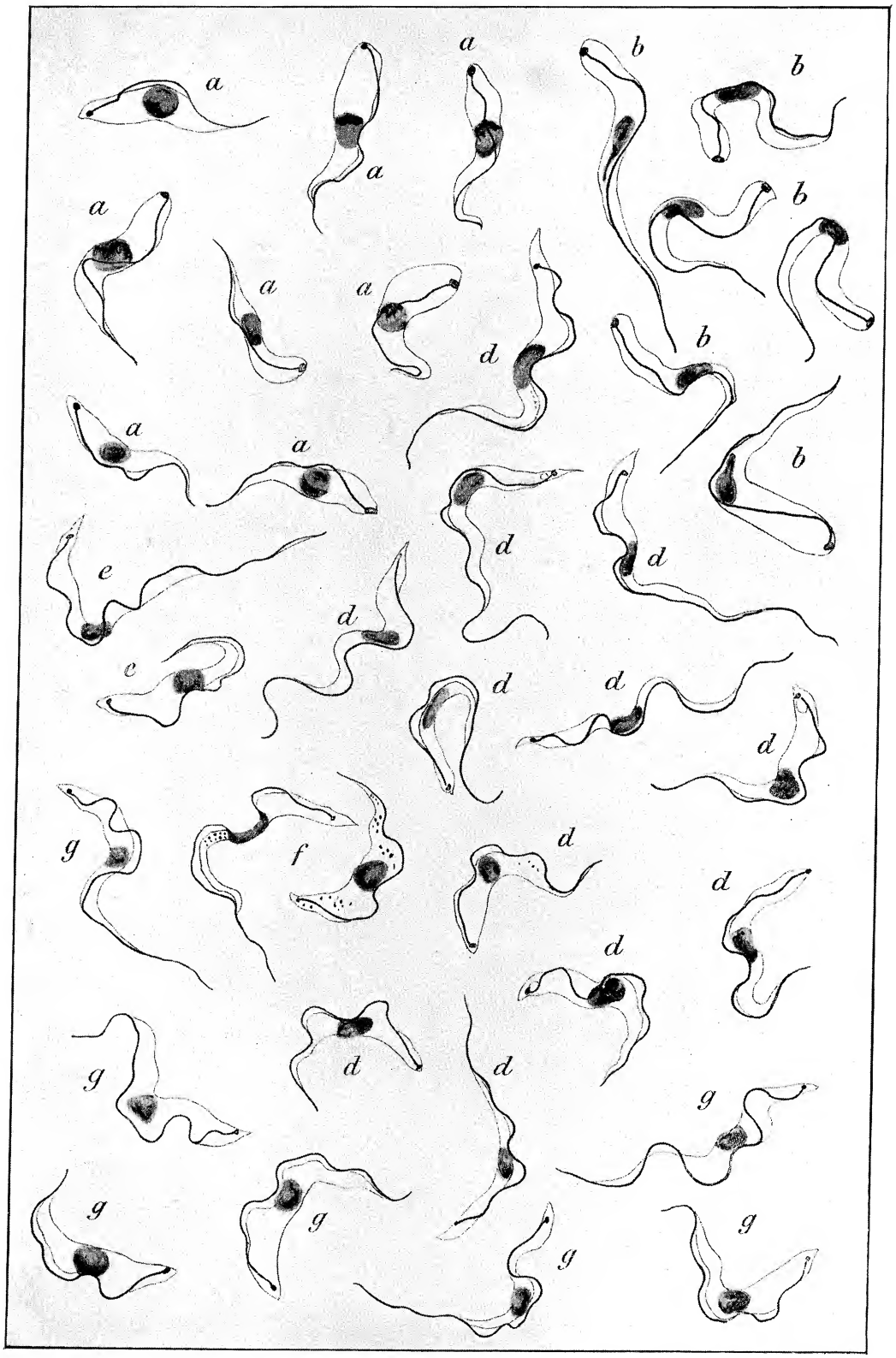
By this means *T. uniforme* was identified in the blood of Situtunga 510, and in the case of Goat 512 all three species were recognisable.

(2) Examination of stained films.

T. uniforme identified in blood of Situtunga 510.

maxim., 19·00 μ; minim., 14·5 μ; average, 15·9 μ (dry fixation).

* Laveran and Mesnil, 'Trypanosomes et Trypanosomiasis,' 1904.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T. vivax in Goat 512.

maxim., 27·0 μ; minim., 20 μ; average, 23·9 μ (osmic acid fixation).

T. gambiense in Goat 512.

T. vivax and *T. gambiense* in centrifugalised blood of Goat 512.

(3) Sub-inoculation.

The blood of Goat 512 inoculated into Monkey 525 produced *T. gambiense* in the blood of the monkey.

Conclusions.

(1) That the continued infectivity of the wild *G. palpalis* on Damba Island to monkeys may be explained by the fact that the situtunga on that island are acting as a reservoir to *T. gambiense.*

(2) That the continued infectivity of the mainland flies to *T. gambiense* may probably be explained on a similar hypothesis, including possibly the other species of antelope frequenting the lake shore, *i.e.* waterbuck, bushbuck, duiker and reedbuck.

(3) That no positive evidence can be adduced from the above experiments to show that hippopotamus can serve as a reservoir.

(4) That the continued infectivity of the lake-shore flies to *T. vivax* and *T. uniforme* is also due to the antelope which serve as a reservoir for these trypanosomes.

DESCRIPTION OF PLATE.

(All drawn at magnification of 2000 diameters.)

a. *T. uniforme* from blood of Situtunga 511. Fixed by *drying only* followed by absolute alcohol.

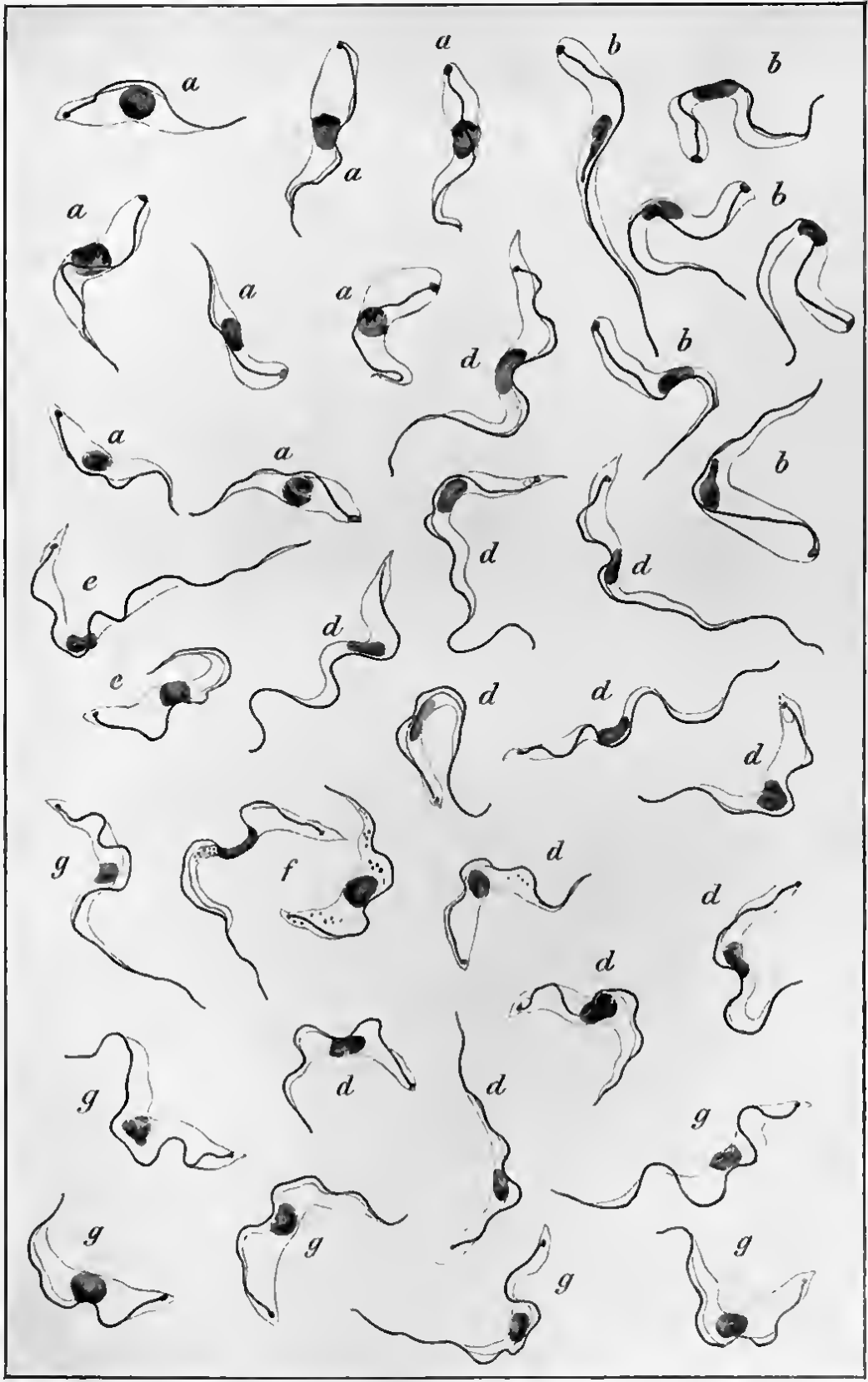
b. *T. vivax* from blood of Goat 512. Fixed with osmic acid followed by absolute alcohol.

d. *T. gambiense* from blood of Monkey 401, which was infected from Situtunga 402-403. Fixed osmic acid followed by absolute alcohol.

e. *T. gambiense* from blood of Monkey 504, infected by laboratory-bred glossinæ from Monkey 401. Fixed osmic acid followed by absolute alcohol.

f. *T. gambiense* from blood of Rat 477, infected from Monkey 401. Fixed osmic acid and absolute alcohol.

g. *T. gambiense* from blood of Monkey 511, infected from Situtunga 509 510. Fixed osmic acid and absolute alcohol.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